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23 JUN 1999

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23JUN99 E456425-5 D02884  
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# Request for grant of a patent

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The Patent Office

Cardiff Road  
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1. Your reference  
P22196/EBA/SCR/NPA
2. Patent application number  
(The Patent Office will fill in this part)  
**9914510.4** **23 JUN 1999**
3. Full name, address and postcode of the or of each applicant (underline all surnames)  
Patents ADP number (if you know it)  
If the applicant is a corporate body, give the country/state of its incorporation  
Milliken Industrials Limited  
Wellington Street  
Bury  
LANCS  
BL8 2AY  
**605618001**  
United Kingdom
4. Title of the invention  
"Method of Colouring Materials"
5. Name of your agent (if you have one)  
"Address for service" in the United Kingdom to which all correspondence should be sent (including the postcode)  
Murgitroyd & Company  
373 Scotland Street  
GLASGOW  
G5 8QA  
Patents ADP number (if you know it)  
1198013
6. If you are declaring priority from one or more earlier patent applications, give the country and the date of filing of the or of each of these earlier applications and (if you know it) the or each application number  

Country	Priority application number (if you know it)	Date of filing (day / month / year)
---------	--	-------------------------------------
7. If this application is divided or otherwise derived from an earlier UK application, give the number and the filing date of the earlier application  

Number of earlier application	Date of filing (day / month / year)
-------------------------------	-------------------------------------
8. Is a statement of inventorship and of right to grant of a patent required in support of this request? (Answer 'Yes' if:  
a) any applicant named in part 3 is not an inventor, or  
b) there is an inventor who is not named as an applicant, or  
c) any named applicant is a corporate body.  
See note (d))  
Yes

Patents Form 1/77

9. Enter the number of sheets of any of the following items you are filing with this form. Do not count copies of the same document

Continuation sheets of this form -

Description 9

Claim(s) -

Abstract -

Drawing(s) 6

10. If you are also filing any of the following, state how many against each item.

Priority documents -

Translations of priority documents -

Statement of inventorship and right to grant of a patent (Patents Form 7/77) -

Request for preliminary examination and search (Patents Form 9/77) -

Request for substantive examination (Patents Form 10/77) -

Any other documents (please specify) -

11. I/We request the grant of a patent on the basis of this application.

Signature  Date 22 June 1999  
Murgitroyd & Company

12. Name and daytime telephone number of person to contact in the United Kingdom Norman Pattullo - 0141 307 8400

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1     **METHOD OF COLOURING MATERIAL**

1     The present invention relates to a new method of  
2     colouring material, and especially to a new method of  
3     dyeing woven or not woven material which provides the  
4     material with an high visibility colour; to the dyed  
5     material thus obtained and to the use of such material  
6     in the manufacture of products to be used for example  
7     in sports and especially in the covering of tennis  
8     balls.

9

10    Traditionally, tennis balls were covered with a white  
11    woollen felt. Several decades ago yellow felt was  
12    introduced for use on match quality balls and from the  
13    early 1970's balls covered with yellow felt became  
14    increasingly popular. Today, the vast majority of  
15    tennis balls are covered with yellow felt. Rule 3 of  
16    the International Tennis Federation Rules of Tennis  
17    states "The ball shall have a uniform outer surface  
18    consisting of a fabric cover and shall be white or  
19    yellow in colour..."

20

21    The felt used on tennis balls was previously made in  
22    wool. Nowadays such felt is usually made of a mixture  
23    of wool and nylon fibres at a ratio of about 50% each,  
24    and it is desirable that the back side of the felt  
25    (which is the side which will be stuck to the ball) be  
26    made of a material which provides a good adhesion when

1 it is glued on the internal rubber sphere of the ball.  
2 Usually such backing is made of cotton).

3

4 The tennis ball felt is then preferably dyed with a  
5 fluorescent dyestuff. That is, the coloured felt will  
6 absorb ultra-violet light and re-emit the absorbed  
7 energy in the visible area of the spectrum. Most  
8 tennis balls are now covered with felt that is dyed  
9 fluorescent yellow and which produces peak reflectance  
10 values of over 100% in the yellow area of the spectrum.

11

12 Few manufacturers produce fluorescent dyestuffs  
13 suitable for both wool and polyamide fibres. To the  
14 best of the Applicant's knowledge all the major tennis  
15 ball felt manufacturers use the same class of dyestuff  
16 albeit from different dyestuff suppliers. This class  
17 of dyestuff gives a hue (colour) slightly to the green  
18 side of yellow.

19

20 The cones in the human eye are mainly responsible for  
21 daylight colour vision and these give the eye the  
22 highest visual efficiency in the yellow wavelengths.

23

24 In addition to percentage reflectance three other  
25 values can be plotted to identify a colour :

26

27 Lightness, with a scale of 0 to 100; 0 being black and  
28 100 white;

29

30 Hue, which can be shown as a circle with red at 0  
31 degrees and yellow, green and blue at 90 degree  
32 intervals from this, the exact angle therefore  
33 indicating the hue. If the lightness is visualised as  
34 a vertical axis passing through the centre of the hue  
35 circle, then a colour can be plotted in three  
36 dimensional space; and



1 Chroma or colour saturation which can be shown as the  
2 distance along a given radius from the centre of the  
3 hue circle.

4  
5 In the mid 1990's a high visibility felt (or HVF) was  
6 produced using an increased percentage of dyestuff.  
7 This felt (or HVF) has a higher level of saturation  
8 (Chroma) but actually has a slight reduction in peak  
9 reflectance and in lightness when compared to some  
10 standard coloured felt. A method has now been found  
11 which allows the production of coloured felt for tennis  
12 balls having enhanced visibility properties over the  
13 prior art.

14  
15 The invention also provides a method of dyeing material  
16 which produces an Ultra High Visibility (UHV) felt  
17 which mitigates shortfalls of HVF.

18  
19 More particularly, the invention provides a method of  
20 colouring material which comprises contacting said  
21 material with a bleaching agent prior to or  
22 simultaneously with contacting said material with a  
23 dyestuff providing said colour.

24  
25 Preferably the material to be dyed is made of a mixture  
26 of fibres of different nature, as, for example, a  
27 mixture of wool and polyamide fibres.

28  
29 It is also preferred that the material be a felt and  
30 more particularly a felt suitable for the covering of  
31 tennis balls, such as a felt made of wool and polyamide  
32 fibres. In cases where a mixture of fibres are present  
33 it is recommended to contact the material also with a  
34 partitioning agent in order to eliminate or reduce the  
35 difference in uptake of the dyestuff between the  
36 different types of fibres. The bleaching agent, which

1 is preferably a reduction bleaching agent, whitens the  
2 initial colour of at least one of the fibres.

3

4 Preferably the liquor ratio used to run the machine is  
5 in the range between 6:1 and 8:1.

6

7 It is further preferred that the pH is adjusted  
8 preferably between 4.2 and 4.5 by using, for example,  
9 formic acid. The temperature is then raised to a  
10 suitable temperature, for example about 45°C and held  
11 for a period of, typically, 3 minutes to be able to  
12 check and if necessary adjust the pH.

13

14 A wide range of suitable partitioning agents are  
15 available depending for example upon the nature of the  
16 material to be treated. However the partitioning agent  
17 sold under the Trade Name BASOPAL NA by BASF has  
18 demonstrated good results. The concentration of  
19 BASOPAL NA recommended is about 0.5 grams per litre of  
20 liquor.

21

22 It is further preferred that the bleaching agent and,  
23 if appropriate, the partitioning agent be contacted for  
24 a reasonable time with the material prior to the dyeing  
25 step being executed.

26

27 It is further preferred that the bleaching agent be  
28 added simultaneously or quasi-simultaneously with the  
29 partitioning agent.

30

31 The bleaching agent preferably used is the one sold  
32 under the Trade Name LUFIBROL FW by BASF. The amount  
33 of LUBRIFOL FW is advantageously about 2% of the weight  
34 of fibre.

35

36

1 It is further preferred to use a yellow dye, as this  
2 colour is highly desirable for the manufacture of  
3 tennis balls. The preferred yellow dye which can be  
4 used according to the invention is the one sold under  
5 the Trade Name NYLOMINE FLAVINE C-7G dyestuff by BASF.  
6 The dyeing process can be performed according to the  
7 recommended practice. A typical method is to add the  
8 dyestuff to the material and the liquor according to a  
9 recommended concentration and the recommended  
10 temperature is then raised and held for some time at  
11 this temperature before rinsing.

12  
13 The invention also relates to the dyed material  
14 obtained according to the method of the invention which  
15 is coloured, preferably in yellow, and displays  
16 enhanced visibility properties. The invention also  
17 relates to the coloured felt itself which displays  
18 enhanced visibility properties.

19  
20 The invention further relates to the used of coloured  
21 material dyed according to the method of the invention  
22 in the manufacture of articles such as sporting  
23 articles and more specifically tennis balls.

24  
25 The present invention will be now further described  
26 with reference to the following, non-limiting example.

27  
28 **Figure 1** shows the reflectance curves of two prior art  
29 felts (Nos 2 & 3) compared with the ultra high  
30 visibility (UHV) felt (No 1) of the invention.

31  
32 **Figure 2** shows the reflectance curves of two other  
33 felts (Nos 4 & 5) produced by the Applicant and  
34 compared with the UHV felt (No 1) of the invention.

35  
36 **Figure 3** shows the same data as Figure 2 but the data

1 used to produce the curves are generated by the  
2 International Tennis Federation on their  
3 spectrophotometer.

4  
5 Figure 4 shows the saturation (chroma) of the UHV felt  
6 (No 1) of the invention compared with the four prior  
7 art felts (Nos 2 to 5) used in Figures 1 to 3.

8  
9 Figure 5 shows the lightness of the same five felts  
10 used in Figure 4.

11  
12 Figure 6 is an attempt to illustrate the position on  
13 the colour circle by both chroma and hue of the five  
14 samples used in Figures 1 to 3, 4 or 5.

15

#### 16 Example 1

17 Obtention of an ultra high visibility yellow felt  
18 according to the method of the invention

19

20 The felt used in this example is a material having an  
21 back surface made mainly in cotton and an external face  
22 made of a wool and polyamide fibre felt. Only the  
23 external surface made of wool and polyamide felt needs  
24 to be coloured. Wool and polyamide are present in a  
25 respective ratio of about 6/4 with respect to the  
26 weight of wool and polyamide fibres. The amount of  
27 cotton fibres in the material represents about 15 % of  
28 the total weight of the material.

29

30 The felt is dyed using acid dyes in piece form using a  
31 Softflow jet dyeing machine which is run at a liquor  
32 ratio of between 6:1 and 8:1. The liquor is the  
33 liquid in which the material is wetted before the  
34 addition of the dyestuff. In most cases and in  
35 particular in this example the liquor is water.

36

1 The dyeing method used in this example is as follows:-

- 2 - The felt is entered into the machine cold and
- 3 the liquor ratio as indicated above;
- 4 - The pH is adjusted between 4.2 and 4.5 with
- 5 formic acid;
- 6 - The temperature is raised to 45°C and held for 3
- 7 minutes whilst checking pH;
- 8 - 0.5 grams per litre of BASOPAL NA (BASF) and 2%
- 9 by weight of fibre of Lufibrol FW (BASF) are added
- 10 through the dosing system; and
- 11 - the machine is run for 5 minutes at 45°C.

12 The following dyeing method is then applied:

- 13 - 1.6% by weight of fibres of NYLOMINE
- 14 FLAVINE C-7G dyestuff is added through the
- 15 dosing system during a period of 2 minutes;
- 16 - the temperature is raised at a rate of
- 17 1.8°C per minute to 95°C and the machine is
- 18 run for 30 minutes at this temperature;
- 19 - the temperature is decreased to 40°C at a
- 20 rate of 2.5°C per minute; and
- 21 - the felt is rinsed twice with fresh water
- 22 and unloaded from the machine.

23

#### 24 Comparative data

25

26 The colour characteristics of the felt dyed according  
27 to the above described method are shown in Figures 1 to  
28 6. Except for Figure 3, all data were measured by the  
29 Applicant using CIE (Commission Internationale  
30 d'Eclairage) CIELAB formula at a 10 degree reflectance  
31 angle using standard D65 illuminant.

32

33 Figure 1 shows reflectance curves of an UHV yellow felt  
34 made according the method described in Example 1 and of  
35 two competing felts produced respectively by the  
36 companies Tretorn Sport and Penn Racquet Sports under

1 the Trade Name TRETORN TXT and PRO PENN. The felts used  
2 to cover these balls are produced by Textech  
3 Industries.

4  
5 Figure 2 shows reflectance curves of the UHV felt used  
6 in Figure 1 and of two other yellow felts, a "standard"  
7 one and an "high visibility" one, both produced by the  
8 company Milliken (Woollen Speciality Products) under  
9 the respective Trade Name PLAYNE'S 14 and PLAYNE'S 45.  
10 These felts are used in the manufacture of tennis balls  
11 such as the ones sold under the Trade Names DUNLOP FORT  
12 (standard) and SLAZENGER WIMBLEDON (high visibility).

13  
14 Figure 3 shows the same data as Figure 2 but the data  
15 used to produce the curves are generated by the  
16 International Tennis Federation (ITF) on their  
17 spectrophotometer. This independent measurement shows  
18 good correlation with the Applicant's own data.

19  
20 Figures 4 and 5 show respectively the chroma and the  
21 lightness of the five tested felts.

22  
23 Figure 6 shows a graph displaying the combination of  
24 both chroma and hue performances of the five tested  
25 felts.

26  
27 As can be seen from Figures 1 to 6, the colour of the  
28 felt of this example of the invention demonstrates  
29 superior characteristics in all areas (i.e. chroma, hue  
30 lightness and reflectance). The performances, when  
31 compared to the closest prior art (i.e. the High  
32 Visibility felt manufacture by Milliken), are  
33 especially better for lightness and reflectance.

34  
35 Figures 2 to 4 & 5 show that the high visibility felt  
36 has a higher level of saturation (Chroma) but actually

1 has a slight reduction in peak reflectance and in  
2 lightness when compared to the standard colour felt.  
3 This disadvantage does not exist with the colour of the  
4 UHV felt.

5  
6 Thus, the UHV felt of the this example of the invention  
7 can be used for the manufacture of yellow tennis balls  
8 of improved colour properties, which is obviously  
9 highly desirable to tennis players. Such improved  
10 properties permit, during a game, a more easy and rapid  
11 capture (catch) of the incoming moving ball by the eyes  
12 of the tennis player and thus a quicker reaction and  
13 positioning of the player with respect the ball.

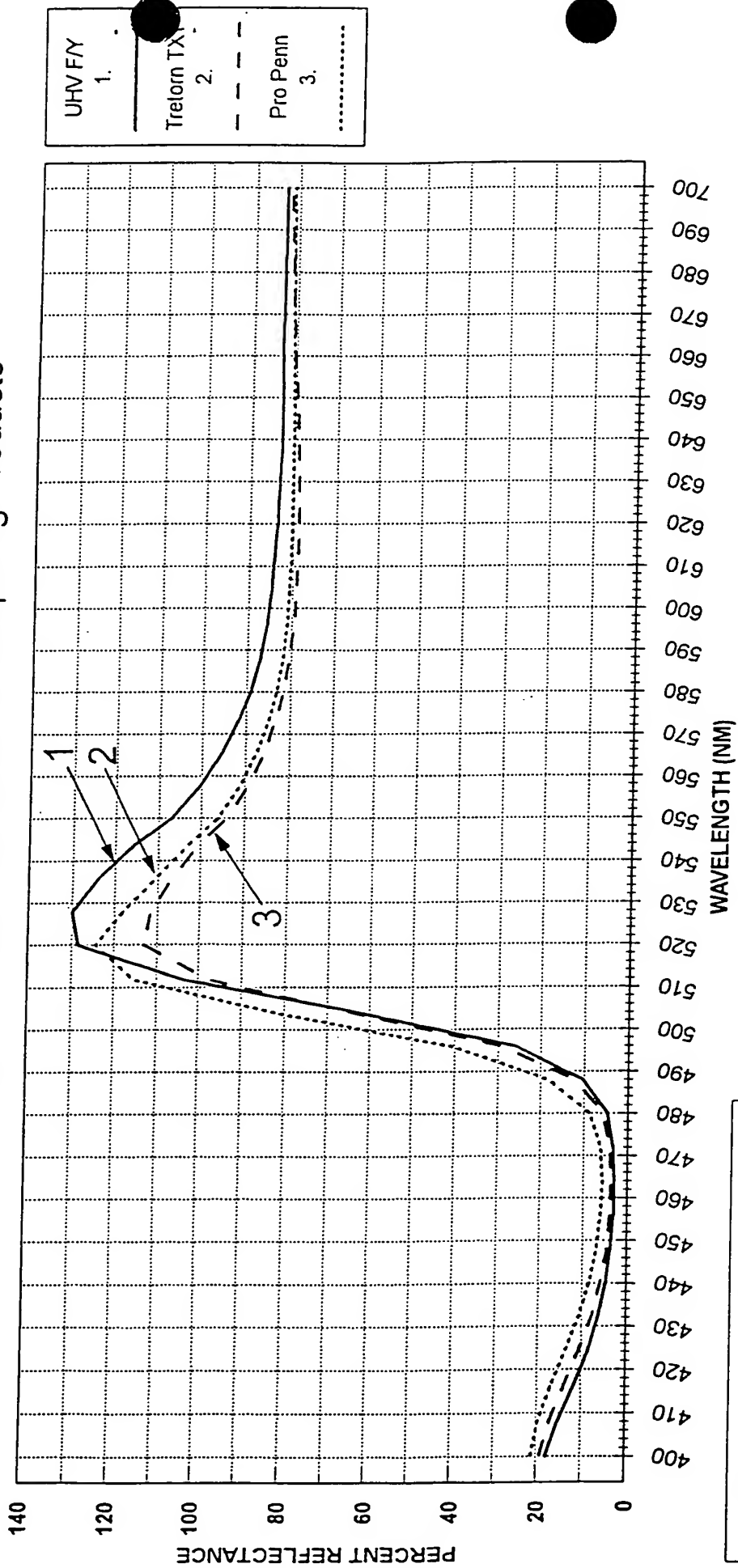
14  
15 The method and the product thus produced according to  
16 the invention may be used for other purposes than  
17 covering tennis balls. The high visibility of colour  
18 material of the invention could also be used for  
19 producing other items than tennis balls, especially  
20 those where high visibility is important.

21

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# Tennis Felt Reflectance Chart Spectrophotometer Evaluation of Competing Products

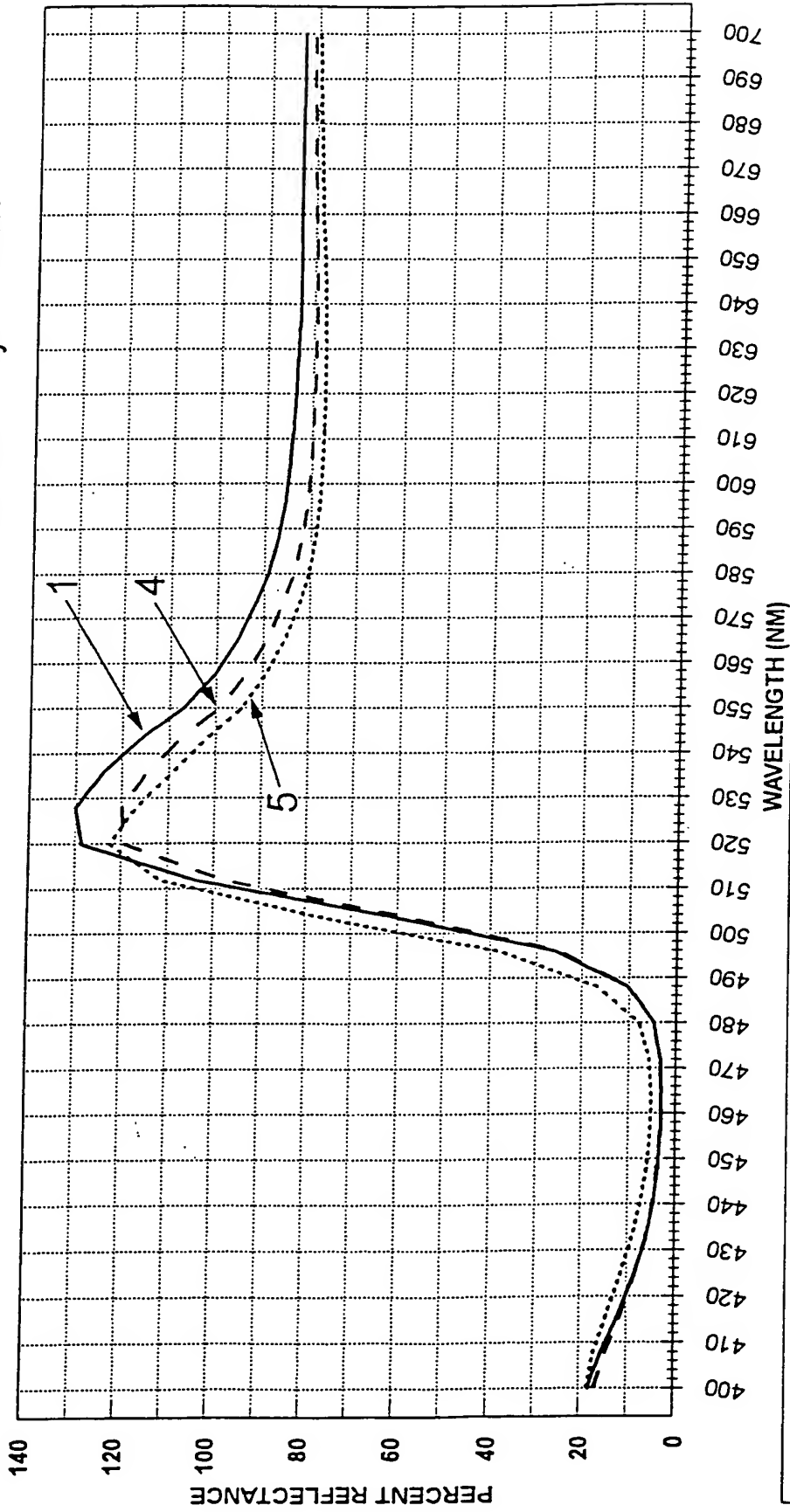


1 - UHV F/Y New Milliken development colour  
2 - Tretorn TXT - Tretorn TXT ball from market  
3 - Pro Penn - Pro Penn ball from market

FIGURE 1

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# Milliken Tennis Felt Reflectance Chart Comparative Spectrophotometer Evaluation by Milliken



- 5 - Std.FY - Current standard product
- 4 - Hi.Viz.FY - High Visibility colour used on Slazenger Wimbledon ball
- 1 - UHV FY - New development colour

FIGURE 2

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# Milliken Tennis Felt Reflectance Chart Comparative Spectrophotometer Evaluation by I.T.F.

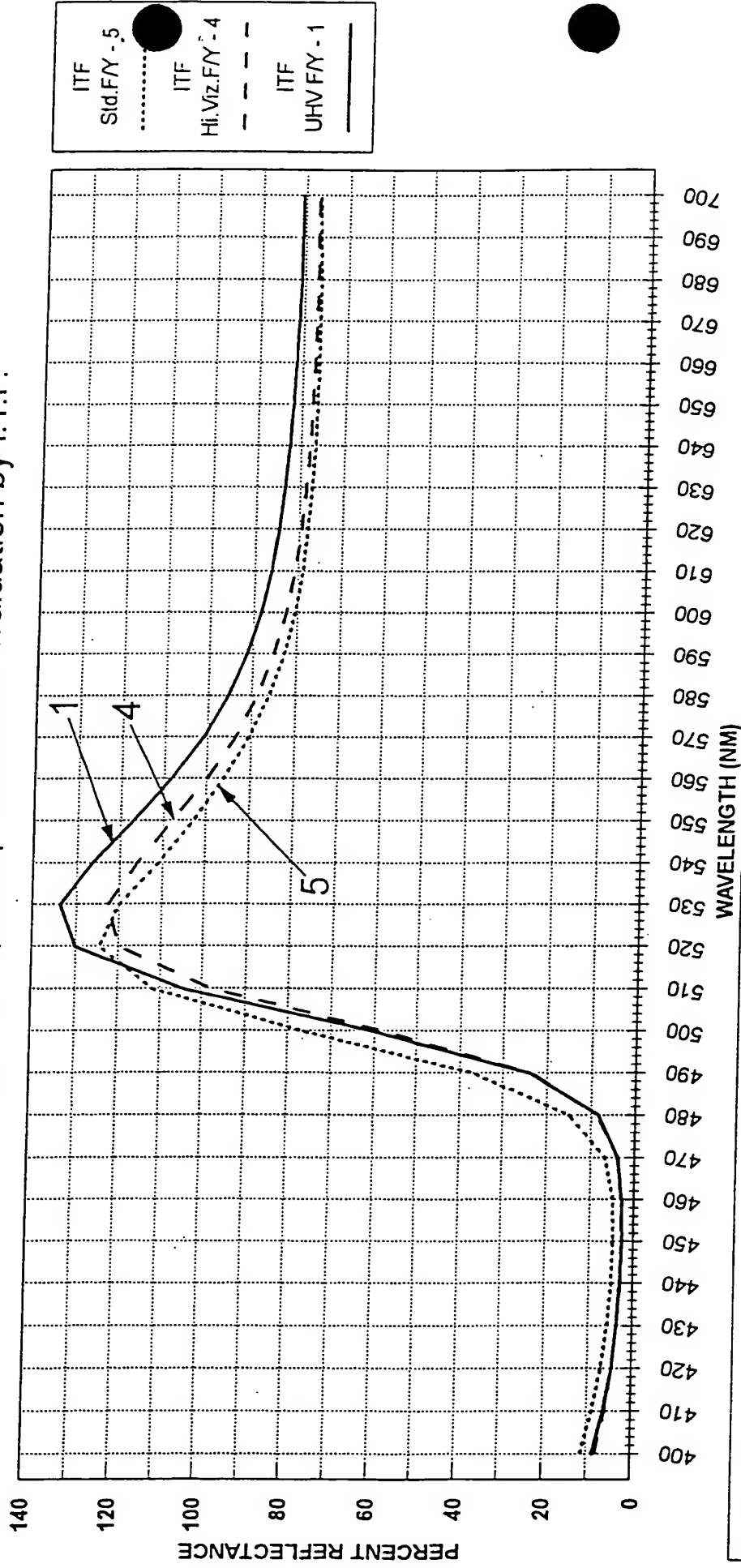


FIGURE 3

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# Tennis Felt Comparison Spectrophotometer Evaluation of Competing Products Chroma (Saturation)

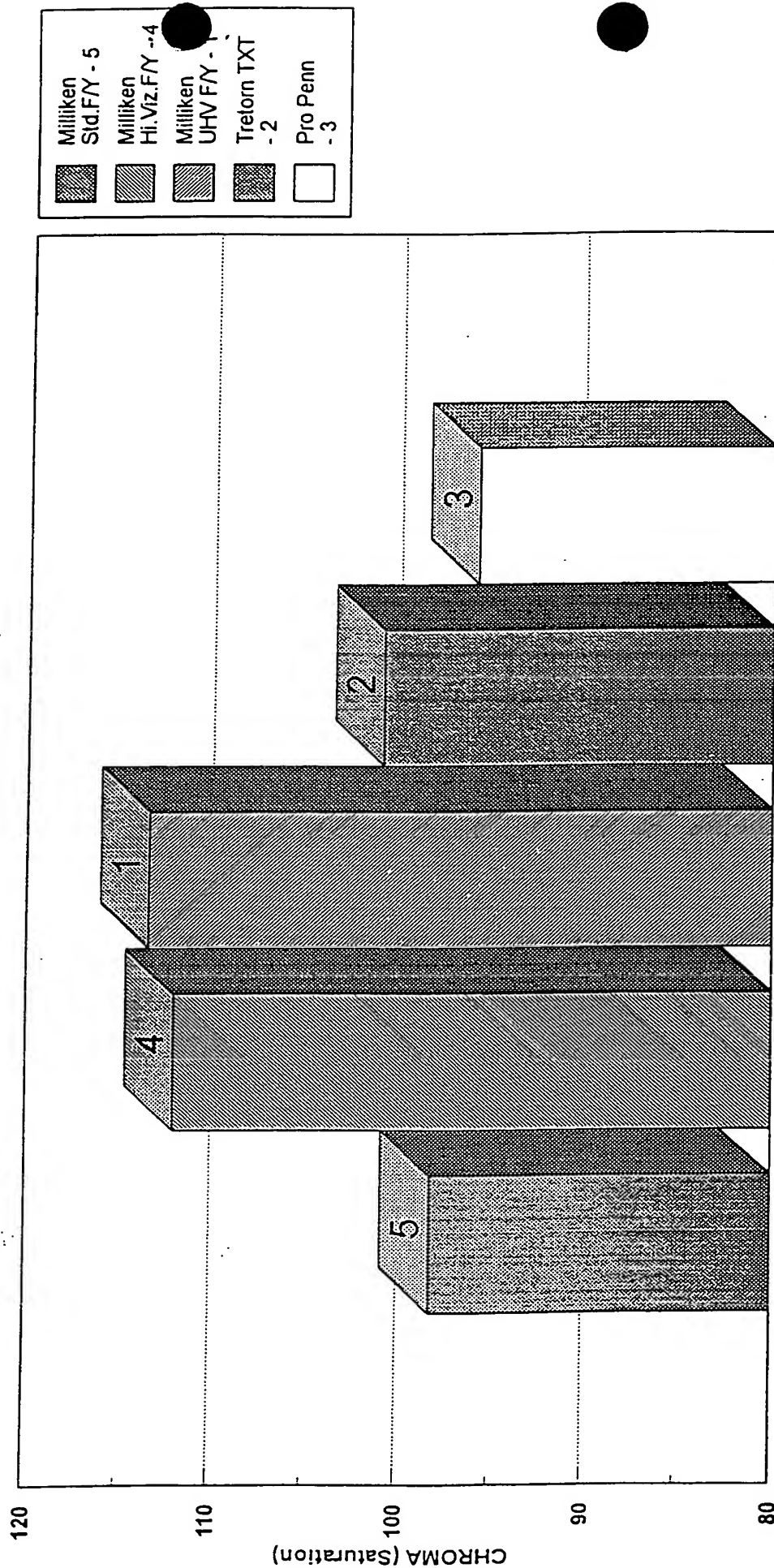


FIGURE 4

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# Tennis Felt Comparison

## Spectrophotometer Evaluation of Competing Products

### Lightness

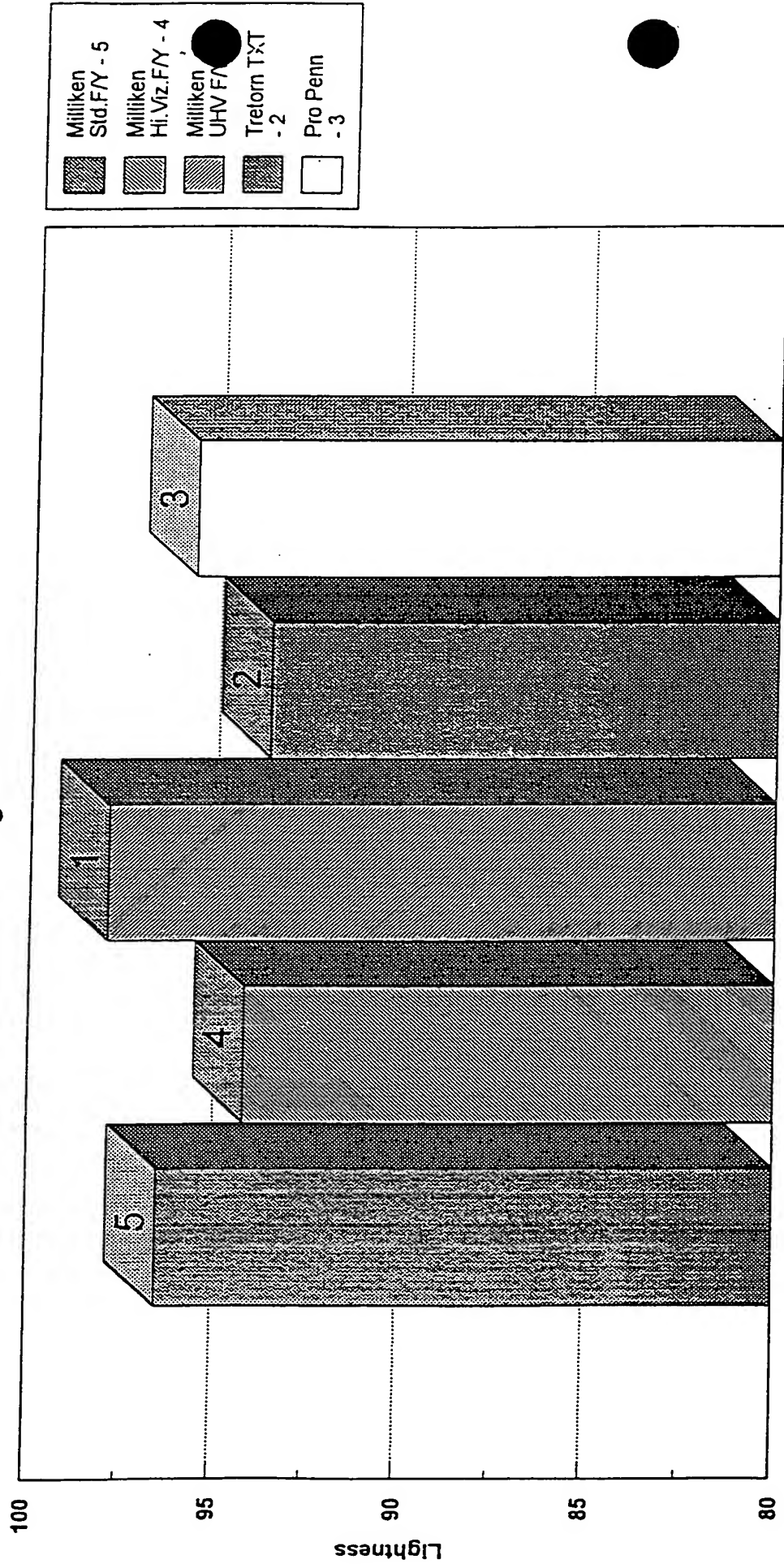


FIGURE 5

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# PLOT TO SHOW COLOUR COMPARISON OF TENNIS BALL FELT (CHROMA & HUE)

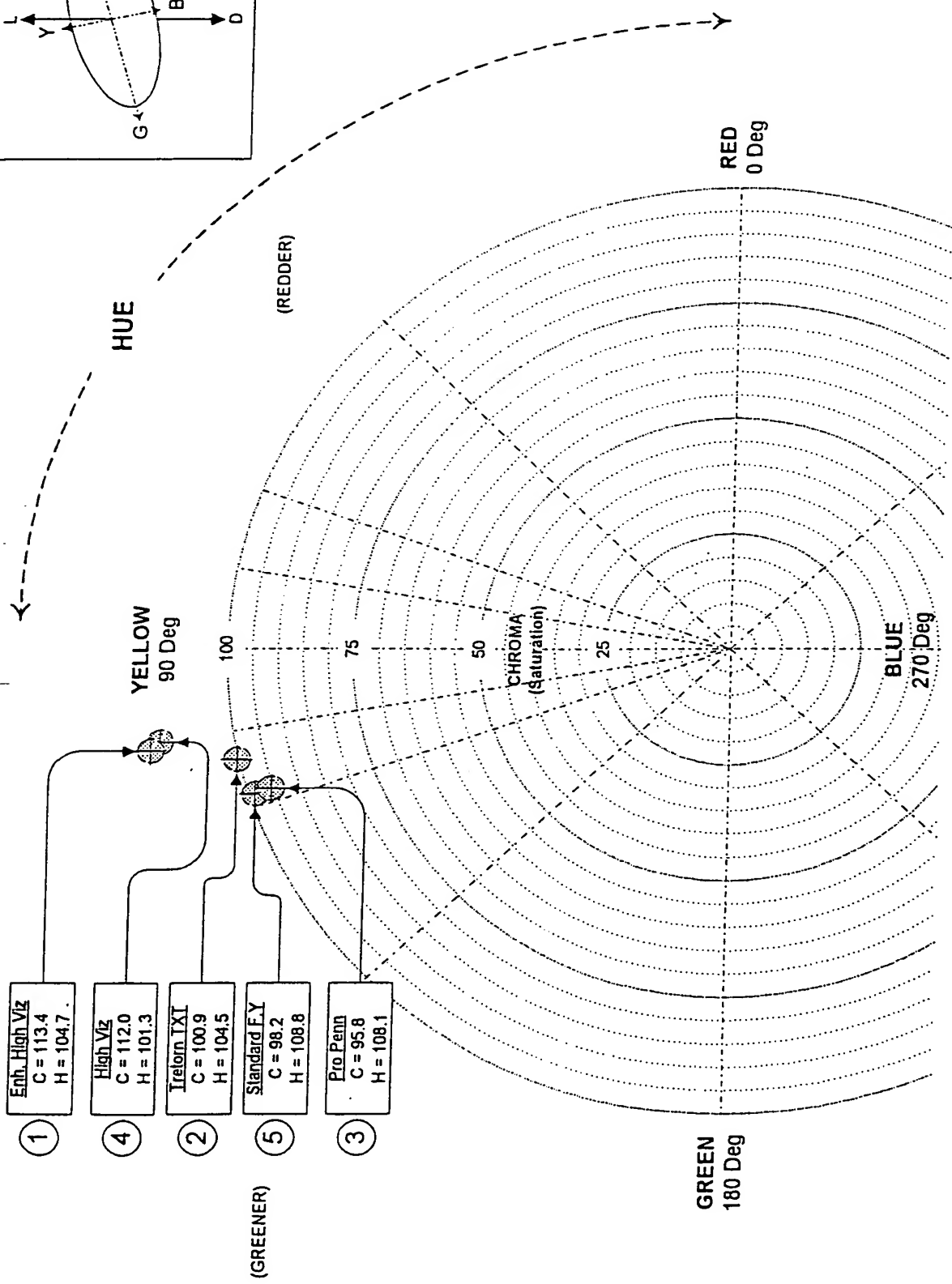
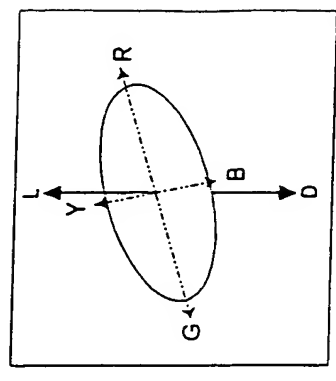


FIGURE 6

ACT NO : 6805 02290

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